

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		041463-5026 U.S. Application No. Unassigned 09/787942
International Application. No.	International Filing Date	Priority Date Claimed
PCT/CH99/00450	September 22, 1999	September 25, 1998

Title of Invention
ANTIFALSIFICATION PAPER AND OTHER ANTIFALSIFICATION ITEMS

Applicants For DO/EO/US
Christoph WEDER and Paul SMITH

Applicants herewith submit to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

- ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
- ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
- ☐ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(I).
- ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
- ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
- ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
- ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
- ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
- ☐ An oath or declaration of the inventors (35 U.S.C. 371(c)(4)).
- ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

ns 11. to 14. below concern other document(s) or information included:

- ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
- ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
- ☒ A FIRST preliminary amendment.
- ☐ A SECOND or SUBSEQUENT preliminary amendment.
- ☒ Other items or information:
 - a. PCT/IPEA/416 (In German)
 - b. International Preliminary Examination Report - PCT/IPEA/409 (In German)
 - c. International Search Report - PCT/ISA/210 (In German)

U.S. APPLICATION NO.

INTERNATIONAL APPLICATION NO.

JC03/Rec'd PCT/PTO 23 MAR 2001
ATTORNEY DOCKET NUMBER

09/787942

PCT/CH99/00450

041463-5026

[X] The following fees are submitted:

Basic National Fee (37 CFR 1.492(a)(1)-(5)):

Search Report has been prepared by the EPO or JPO.....\$860.00

International preliminary examination fee paid to

USPTO (37 CFR 1.482).....\$690.00

No international preliminary examination fee paid to

USPTO (37 CFR 1.482) but international search fee
paid to USPTO (37 CFR 1.445(a)(2)).....\$710.00

Neither international preliminary examination fee

(37 CFR 1.482) nor international search fee

(37 CFR 1.445(a)(2)) paid to USPTO.....\$1000.00

International preliminary examination fee paid to USPTO

(37 CFR 1.482) and all claims satisfied provisions

of PCT Article 33(2)-(4).....\$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT = \$ 860.00

charge of \$130.00 for furnishing the oath or declaration later than

20 [] 30 months from the earliest claimed priority date

CFR 1.492(e)).

Claims	Number Filed	Number Extra	Rate	
Initial Claims	60-20 =	40	X \$18.00	\$ 720.00
Dependent Claim	4- 3 =	1	X \$80.00	\$ 80.00
Multiple dependent claim(s) (if applicable)			+ \$270.00	\$ 270.00

TOTAL OF ABOVE CALCULATIONS = \$1930.00

Reduction by 1/2 for filing by small entity, if applicable. Verified

Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28)

SUBTOTAL = \$1930.00

Processing fee of \$130.00 for furnishing the English translation later

[] 20 [] 30 months from the earliest claimed priority date

CFR 1.492(f)).

+\$

TOTAL NATIONAL FEE = \$1930.00

For recording the enclosed assignment (37 CFR 1.21(h)). The

assignment must be accompanied by an appropriate cover sheet

CFR 3.28, 3.31). \$40.00 per property

+\$

TOTAL FEES ENCLOSED = \$1930.00

Amount to be

refunded

\$

charged

\$

a. [] A check in the amount of \$_____ to cover the above fees is enclosed.

b. [X] Please charge my Deposit Account No. 50-0310 in the amount of \$1930.00
to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] Except for issue fees payable under 37 C.F.R. §1.18, the Commissioner is hereby authorized by this paper to
charge any additional fees during the entire pendency of this application including fees due under 37 CFR §1.16
and §1.17 which may be required, or credit any overpayment to Deposit Account No. 50-0310.

Reg. No. 009629


ALL CORRESPONDENCE TO:

Mr. Lewis & Bockius LLP

414 Street, N.W.

Washington, D.C. 20036

202-667-7000



Robert J. Goodell

Reg. No. 41,040

Submitted: March 23, 2001

09/787942

JC03/Rec'd PCT/PTO 23 MAR 2001

PATENT
ATTORNEY DOCKET NO.: 041463-5026

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)
)
Christoph WEDER et al.)
)
Application No.: Unassigned) Group Art Unit: Unassigned
)
U.S. National Stage Application of) Examiner: Unassigned
PCT International Application No.:)
PCT/CH99/00450)
)
International Filing Date:)
22 September 1999)
)
For: ANTIFALSIFICATION PAPER AND)
OTHER ANTIFALSIFICATION)
ITEMS)

Commissioner for Patents
Box PCT
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Prior to an examination on the merits, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Please amend the specification as follows:

Replace paragraph [0001] with the following paragraph:

-- The present invention relates to security paper and security items in general, i.e., items whose counterfeiting is to be prevented or made difficult by one or more security elements,

where the security elements have at least one photoluminescent segment. The present invention also relates to a method of producing such security items as well as a method of using same. --

Replace paragraph [0004] with the following paragraphs:

-- However, one serious disadvantage of all these known security elements is that either the characteristic authenticity features are relatively difficult for a layperson to discern or they require complex equipment for detection, or on the other hand, an easily detectable authenticity feature may be counterfeited relatively easily. However, it is in the nature of the matter that security items are often replaced by newer products with newer security elements after a comparatively short period of time, in particular to prevent counterfeiting and other forms of abuse. Therefore, there has been an urgent need for new, secure and easily discernible security elements for security papers and for security items in general.

One solution that is interesting in this regard has already been described in International Patent Application WO-A-98 01817, where photoluminescence polarizers, where the emitted luminescence light is linearly polarized, are used as security elements for security objects. When this light is observed through a polarizer and the polarizer is rotated, the result for the observer is a light-dark effect because of the luminescence light which is either transmitted or not transmitted through the polarizer, depending on the rotational position. Although U.S. Patent Application 5,284,364 uses polarizers for security purposes, they are "ordinary" polarizers such as $\lambda/2$ layers and are not photoluminescence polarizers.

SUMMARY OF THE INVENTION

One object of the present invention is to eliminate the above-mentioned disadvantages of the previously known security elements and to create security papers and other security items which are characterized by secure and easily discernible security elements. Another object of the invention is to create security papers and other security items whose identification is permitted or facilitated by such security elements or whose authenticity or validity is identified by such security elements. Additional objects of the present invention include the development of a method for producing these security items as well as the use thereof. The solution to these objects is characterized in the independent claims. --

IN THE CLAIMS:

Please cancel claims 1-17 without prejudice or disclaimer.

Please add new claims 18-69 as follows:

-- 18. A security item comprising at least one security element having at least one photoluminescent segment with a linearly polarized photoluminescence, wherein the segment has a dichroic ratio of 5 or more in emission.

19. The security item of claim 18, wherein the security element is in a form selected from a group consisting of fibers, threads, strips, films, sheets, layers, tapes, plates, disks, chips and/or combinations thereof.

20. The security item of claims 18 or 19, wherein apart from the security element, the security item consists mainly of paper.

21. The security item of claims 18 or 19, wherein apart from the security element, the security item contains one or more synthetic polymers.

22. The security item of claim 18, wherein the security element can be excited to luminescence by irradiation with electromagnetic radiation at a wavelength between 200 and 400 nm.

23. The security item of claim 18, wherein the security element includes at least one carrier polymer and one luminescent dye.

24. The security item of claim 23, wherein the luminescent dye is at least one partially conjugated polymer.

25. The security item of claim 23, wherein the luminescent dye is a poly-*p*-phenylene-ethynylene derivative.

26. The security item of claim 18, wherein counterfeiting of the security item is made difficult or impossible.

27. The security item of claim 18, wherein the authenticity and/or validity of the security item is identified.

28. The security item of claim 18, wherein the identification of the security item is permitted or simplified.

29. The security item of claim 18, wherein the security item is in a form selected from a group consisting of bank notes, checks, stocks, bonds, securities, identification cards, passports, drivers licenses, admission tickets, stamps, bank cards and credit cards.

30. A security item comprising at least one security element having at least one photoluminescent segment with a linearly polarized absorption, wherein the segment has a dichroic ratio of 2 or more in absorption.

31. The security item of claim 30, wherein the segment has a dichroic ratio of 5 or more in absorption.

32. The security item of claim 30, wherein the segment has a dichroic ratio of 10 or more in absorption.

33. The security item of claim 30, wherein the security element is in a form selected from a group consisting of fibers, threads, strips, films, sheets, layers, tapes, plates, disks, chips and/or combinations thereof.

34. The security item of claims 30 or 33, wherein apart from the security element, the security item consists mainly of paper.

35. The security item of claims 30 or 33, wherein apart from the security element, the security item contains one or more synthetic polymers.

36. The security item of claim 30, wherein the security element can be excited to luminescence by irradiation with electromagnetic radiation at a wavelength between 200 and 400 nm.

37. The security item of claim 30, wherein the security element includes at least one carrier polymer and one luminescent dye.

38. The security item of claim 37, wherein the luminescent dye is at least one partially conjugated polymer.

39. The security item of claim 37, wherein the luminescent dye is a poly-*p*-phenylene-ethynylene derivative.

40. The security item of claim 30, wherein counterfeiting of the security item is made difficult or impossible.

41. The security item of claim 30, wherein the authenticity and/or validity of the security item is identified.

42. The security item of claim 30, wherein the identification of the security item is permitted or simplified.

43. The security item of claim 30, wherein the security item is in a form selected from a group consisting of bank notes, checks, stocks, bonds, securities, identification cards, passports, drivers licenses, admission tickets, stamps, bank cards and credit cards.

44. A method of producing a security item, comprising the step of:
providing the security item with a security element having at least one photoluminescent segment with linearly polarized luminescence, wherein the segment has a dichroic ratio of 5 or more in emission.

45. The method of producing a security item of claim 44, further comprising the step of:
forming the security element from a group consisting of fibers, threads, strips, films, sheets, layers, tapes, plates, disks, chips and/or combinations thereof.

46. The method of producing a security item of claims 44 or 45, further comprising the step of:
forming the security item, apart from the security element, mainly from paper.

47. The method of producing a security item of claims 44 or 45, further comprising the step of:
forming the security item, apart from the security element, from one or more synthetic polymers.

48. The method of producing a security item of claim 44, further comprising the step of:
exciting the security element to luminescence by irradiation with electromagnetic
radiation at a wavelength between 200 and 400 nm.

49. The method of producing a security item of claim 44, further comprising the step of:
including at least one carrier polymer and one luminescent dye in the security element.

50. The method of producing a security item of claim 49, wherein the luminescent dye is
at least one partially conjugated polymer.

51. The method of producing a security item of claim 49, wherein the luminescent dye is
a poly-*p*-phenylene-ethynylene derivative.

52. The method of producing a security item of claim 44, wherein counterfeiting of the
security item is made difficult or impossible.

53. The method of producing a security item of claim 44, further comprising the step of:
identifying the authenticity and/or validity of the security item.

54. The method of producing a security item of claim 44, further comprising the step of:
permitting the identification of the security item.

55. The method of producing a security item of claim 44, further comprising the step of:
forming the security item from a group consisting of bank notes, checks, stocks, bonds,
securities, identification cards, passports, drivers licenses, admission tickets, stamps, bank cards
and credit cards.

56. A method of producing a security item, comprising the step of:
providing an object with a security element having at least one photoluminescent segment
with a linearly polarized absorption, wherein the segment has a dichroic ratio of 2 or more in
absorption.

57. The method of producing a security item of claim 56, wherein the segment has a
dichroic ratio of 5 or more in absorption.

58. The method of producing a security item of claim 56, wherein the segment has a
dichroic ratio of 10 or more in absorption.

59. The method of producing a security item of claim 56, further comprising the step of:
forming the security element from a group consisting of fibers, threads, strips, films, sheets, layers, tapes, plates, disks, chips and/or combinations thereof.

60. The method of producing a security item of claims 56 or 59, further comprising the step of:
forming the security item, apart from the security element, mainly from paper.

61. The method of producing a security item of claims 56 or 59, further comprising the step of:
forming the security item, apart from the security element, from one or more synthetic polymers.

62. The method of producing a security item of claim 56, further comprising the step of:
exciting the security element to luminescence by irradiation with electromagnetic radiation at a wavelength between 200 and 400 nm.

63. The method of producing a security item of claim 56, further comprising the step of:
including at least one carrier polymer and one luminescent dye in the security element.

64. The method of producing a security item of claim 63, wherein the luminescent dye is at least one partially conjugated polymer.

65. The method of producing a security item of claim 63, wherein the luminescent dye is a poly-*p*-phenylene-ethynylene derivative.

66. The method of producing a security item of claim 56, wherein counterfeiting of the security item is made difficult or impossible.

67. The method of producing a security item of claim 56, further comprising the step of: identifying the authenticity and/or validity of the security item.

68. The method of producing a security item of claim 56, further comprising the step of: permitting the identification of the security item.

69. The method of producing a security item of claim 56, further comprising the step of: forming the security item from a group consisting of bank notes, checks, stocks, bonds, securities, identification cards, passports, drivers licenses, admission tickets, stamps, bank cards and credit cards. --

REMARKS

By this Preliminary Amendment, Applicant canceled claims 1-17, and added new claims 18-69.

Applicant respectfully requests that the Examiner consider the above amendment upon initial examination and consideration on the merits of the present application.

Should the Examiner feel that there are any issues outstanding after consideration of this response, the Examiner is invited to contact Applicants' undersigned representative to expedite the prosecution.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached pages are captioned "**Version with markings to show changes made.**"

EXCEPT for issue fees payable under 37 C.F.R. § 1.18, the Commissioner is hereby authorized by this paper to charge any additional fees during the entire pendency of this application including fees due under 37 C.F.R. §§ 1.16 and 1.17 which may be required,

including any required extension of time fees, or credit any overpayment to Deposit Account

50-0310. This paragraph is intended to be a **CONSTRUCTIVE PETITION FOR**

EXTENSION OF TIME in accordance with 37 C.F.R. § 1.136(a)(3).

Respectfully submitted,

MORGAN, LEWIS & BOCKIUS LLP

By: *Paul A. Fournier* *Reg. No. 41,040*

for Paul A. Fournier
Reg. No. 41,023

Dated: March 23, 2001

MORGAN, LEWIS & BOCKIUS LLP

1800 M Street, N.W.

Washington, DC 20036-5869

(202) 467-7000

Customer No. 009629

PAF/SB

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification:

Paragraph [0001] has been amended as follows:

-- The present invention relates to security paper and security items in general, i.e., items whose counterfeiting is to be prevented or made difficult by one or more security elements, **where the security elements have at least one photoluminescent segment.** The present invention also relates to a method of producing such security items as well as a method of using same. --

Paragraph [0004] has been amended as follows:

-- However, one serious disadvantage of all these known security elements is that either the characteristic authenticity features are relatively difficult for a layperson to discern or they require complex equipment for detection, or on the other hand, an easily detectable authenticity feature may be counterfeited relatively easily. However, it is in the nature of the matter that security items are often replaced by newer products with newer security elements after a comparatively short period of time, in particular to prevent counterfeiting and other forms of abuse. Therefore, there has been an urgent need for new, secure and easily discernible security elements for security papers and for security items in general. ~~[Therefore, one]~~

One solution that is interesting in this regard has already been described in International Patent Application WO-A-98 01817, where photoluminescence polarizers, where the emitted luminescence light is linearly polarized, are used as security elements for security objects. When this light is observed through a polarizer and the polarizer is rotated, the result for the observer is a light-dark effect because of the luminescence light which is either transmitted or not transmitted through the polarizer, depending on the rotational position. Although U.S. Patent Application 5,284,364 uses polarizers for security purposes, they are "ordinary" polarizers such as $\lambda/2$ layers and are not photoluminescence polarizers.

SUMMARY OF THE INVENTION

One object of the present invention is to eliminate the above-mentioned disadvantages of the previously known security elements and to create security papers and other security items which are characterized by secure and easily discernible security elements. Another object of the ~~[present]~~ invention is to create security papers and other security items whose identification is permitted or facilitated by such security elements or whose authenticity or validity is identified by such security elements. Additional objects of the present invention include the development of a method for producing these security items as well as the use thereof. ~~[These objects are achieved according to the present invention by the fact that security elements having at least one photoluminescent segment characterized by a linearly polarized photoluminescence and/or~~

ATTORNEY DOCKET NO.: 041463-5026

U.S. National Stage Application of

PCT/CH99/00450

Page 17

~~linearly polarized absorption are used.]~~ The solution to these objects is characterized in the
independent claims. --

In the Claims:

Claims 1-17 have been canceled and new claims 18-69 have been added.

09/24/2004 2:45:23 PM

3/PRTS

09/787942
JC03/Rec'd PCT/PTO 23 MAR 2001
PATENT

ATTORNEY DOCKET NO.: 041463-5026

ANTIFALSIFICATION PAPER AND OTHER ANTIFALSIFICATION ITEMS

FIELD OF THE INVENTION

[0001] The present invention relates to security paper and security items in general, i.e., items whose counterfeiting is to be prevented or made difficult by one or more security elements. The present invention also relates to a method of producing such security items as well as a method of using same.

BACKGROUND OF THE INVENTION

[0002] It is generally known that security elements may be used for security papers and security items in general, for example, for bank notes, checks, stocks and bonds, securities, identification cards, passports, drivers licenses, admission tickets, stamps and similar documents or for bank cards, credit cards and the like, for the purpose of said security elements is to prevent or interfere with counterfeiting of these objects by unauthorized parties (R. van Renesse, Optical Document Security

(1997), Artech House, Boston). Likewise, such security elements are used to identify the validity or authenticity of objects or to permit or facilitate identification of objects in general.

[0003] For example, it is a widespread practice to use security threads or strips which may consist of a metal-coated plastic, for example, in security papers, in particular for use in bank notes and similar valuable papers. If these security threads or strips are embedded in the security paper, for example, which is subsequently printed at any rate, these security elements cannot readily be seen when the object is observed in reflection. However, when light is passed through the object, these security elements appear as a dark shadow and therefore can be observed in transmission. In particular to guarantee protection against counterfeiting of security items such as security papers, many proposals have been made in recent times for providing security elements with certain properties so that not only the presence of security elements per se but also in particular the presence of specific properties should guarantee the authenticity of the object thus secured (U.S. Patent 4,897,300; U.S. Patent 5,118,349; U.S. Patent 5,314,739; U.S. Patent 5,388,862; U.S. Patent 5,465,301; German Patent Application 1,446,851; British Patent 1,095,286). For example, a security thread having a multicolor micro-printing is known from German Patent Application 1,446,851; the printing ink may also be fluorescent in this case. The surfaces printed with different colors are so small or so close together in the case of this thread that they can hardly be differentiated with the naked eye and therefore appear to the observer as a single-color pattern. However, the micro-printing and the different colors can be observed with the help of a magnifying glass or a microscope. A similar security element is described in British Patent 1,095,286, where the micro-printing claimed in the aforementioned patent specification consists of characters and patterns. U.S. Patent 4,897,300, however, describes a security paper in which are embedded several security threads which are printed with different luminescent dyes. In the unexcited state, the latter are

colorless or the same color as the paper and therefore are difficult or impossible for the observer to see. Due to excitation, e.g., irradiation with ultraviolet (UV) light, the security threads assume a luminescence of an extent that permits detection by the naked eye. In addition, characteristic mixed colors are formed by overlapping of security threads of different colors. To further increase the security of security papers, especially bank notes, a security thread or strip of plastic is also integrated into the paper so that the "window" in the paper surface allows a direct view of parts of the surface of the security element, as described in British Patent 1,552,853, British Patent 1, 604, 463 or European Patent 0,059,056, for example.

[0004] However, one serious disadvantage of all these known security elements is that either the characteristic authenticity features are relatively difficult for a layperson to discern or they require complex equipment for detection, or on the other hand, an easily detectable authenticity feature may be counterfeited relatively easily. However, it is in the nature of the matter that security items are often replaced by newer products with newer security elements after a comparatively short period of time, in particular to prevent counterfeiting and other forms of abuse. Therefore, there has been an urgent need for new, secure and easily discernible security elements for security papers and for security items in general. Therefore, one object of the present invention is to eliminate the above-mentioned disadvantages of the previously known security elements and to create security papers and other security items which are characterized by secure and easily discernible security elements. Another object of the present invention is to create security papers and other security items whose identification is permitted or facilitated by such security elements or whose authenticity or validity is identified by such security elements. Additional objects of the present invention include the development of a method for producing these security items as well as the use thereof. These objects are achieved according to the present invention by the fact that security elements having at

least one photoluminescent segment characterized by a linearly polarized photoluminescence and/or linearly polarized absorption are used.

DEFINITIONS

[0005] The term security element refers in general to a shaped object, for example, which may come in a variety of forms including but not limited to fibers, threads, strips, films, sheets, layers, tapes, sheets, disks, chips and/or combinations thereof. The security element may be homogeneous and continuous and may be structured or patterned and may contain several individual elements, zones or pixels.

[0006] The term security item refers to objects whose counterfeiting is to be prevented or made difficult by one or more security elements or whose authenticity or validity is to be identified by means of one or more security elements or which are to be identified by one or more security elements including but not limited to bank notes, checks, stocks and bonds, securities, identification cards, passports, drivers licenses, admission tickets, stamps, bank cards and credit cards. The term security paper refers to security items made essentially of paper.

[0007] To describe the functioning and properties of segments, security elements, security items and the conditions of experiments, the following conventional definitions of different axes are used here:

[0008] The polar axis of a linear polarizer or analyzer is the direction of the electric field vector of the light transmitted through the polarizer or analyzer. The polarization axis of a segment or security element of another object, if applicable accordingly, is the direction of the electric field vector of the light emitted or absorbed by the corresponding segment, security element or other object.

[0009] A segment is understood in the present patent specification to refer to a portion of an object, in particular a security element on which the characteristic degree of polarization and the polarization axis for emission and absorption can be determined in an adequate manner.

[0010] The degree of polarization for the emission is expressed in this patent specification by the dichroic ratio in emission. The dichroic ratio in emission is defined as the ratio of the integrated photoluminescence of emission spectra measured with unpolarized excitation by a linear polarizer whose polar axis is parallel and normal to the polarization axis of the segment investigated.

[0011] The degree of polarization for the absorption is expressed in this patent publication by the dichroic ratio in absorption. The dichroic ratio in absorption is defined as the ratio of absorption measured at the excitation wavelength by a linear polarizer (analyzer) whose polar axis is parallel and normal to the polarization axis of the segment investigated.

[0012] The excitation wavelength is defined in this patent specification as the wavelength used for optical excitation to photoluminescence of the security element or its photoluminescent segments. The terms absorption and emission refer to optical processes.

DESCRIPTION OF THE FIGURES

Figure 1:

[0013] Dichroic properties of a film of 2 percent by weight EHD-OPPE/UHMW-PE with a drawing rate of 80 (referred to as material A in the following examples). Top: polarized absorption spectra recorded for incident light polarized parallel (solid line) and normal (dotted line) to the polarization axis of the film. Bottom: polarized emission spectra under isotropic excitation at 365 nm, measured by a polarizer (analyzer) with its polar axis parallel (solid line) and normal (dotted line) to the polarization axis of the film.

Figure 2:

[0014] Graphic plot of the dichroic ratio in absorption and the dichroic ratio in emission for a series of previously known photoluminescent materials with linearly polarized emission and linearly polarized absorption; these materials are suitable in part for use in security elements according to the present invention, plotted as a function of the drawing rate (shown in the graph), composition and chemical structure of the luminescent dye.

Figure 3:

[0015] Simplified graphic plot of security items according to the present invention.

DETAILED DESCRIPTION OF THIS INVENTION

[0016] The present invention is based on our surprising discovery that security elements which can be used for production of security papers and security items in general can be fabricated from photoluminescent materials which are characterized by a linearly polarized photoluminescence or linearly polarized absorption or both and can be converted to a form according to this invention. In particular, we have discovered that the security papers and security items in general according to this invention are characterized by a great security against counterfeiting and easily discernible authenticity features.

[0017] The fact that certain luminescent materials have a linearly polarized absorption and emission behavior has been known per se for a long time. These effects were first observed in inorganic crystals (E. Lommel, Ann. d. Physik und Chemie, Vol. 8, pp. 634-640 (1879)) and later in oriented films of mixtures of ductile polymers and luminescent dyestuffs (A. Jablonski, Acta Phys.

Polon., Vol. A 14, pp. 421-434 (1934)). Since then, numerous materials characterized by linearly polarized absorption and emission have become known (J. Michl et al. Spectroscopy with Polarized Light (1986) VCH Publishers, New York), such as oriented mixtures of ductile polymers and oligomeric photoluminescent materials with a significantly uniaxial component (M. Hennecke et al., Macromolecules, Vol. 26, pp. 3411-3418 (1993)), oriented photoluminescent polymers (P. Dyreklev et al., Adv. Mat., Vol. 7, pp. 43-45 (1996)) or mixtures of photo luminescent and ductile polymers (U.S. Patent 5,204,038; T. W. Hagler et al., Polymer Comm., Vol. 32, pp. 339-342 (1991); Ch. Weder et al., Adv. Mat., Vol. 9, pp. 1035-1039 (1997)), liquid crystal in systems (N. S. Sariciftci et al., Adv. Mater., Vol. 8, p. 651 (1996); G. Lüssem et al., Adv. Mater., Vol. 7, P. 923 (1995)) or oriented photoluminescent materials grown on orienting substrates (K. Pichler et al., Synth. Met., Vol. 55-57, p. 454 (1993) ; N. Tanigaki et al., Mol. Cryst. Liq. Cryst., Vol. 267, p. 335 (1995); G. Lüssem et al., Liq. Cryst., vol. 21, p. 903 (1996) ; R. Gill et al. , Adv. Mater., vol. 9, pp. 331-334 (1997)). Only recently have photoluminescent materials having an essentially unpolarized absorption behavior but a linearly polarized emission have also been described (C. Weder et al., Nature, vol. 392, p. 261; European Patent Application 98101520.9). Likewise, photoluminescent materials having a linearly polarized absorption and an essentially unpolarized emission have also been obtained (European Patent Application 97111229.7; European Patent Application 98101520.9).

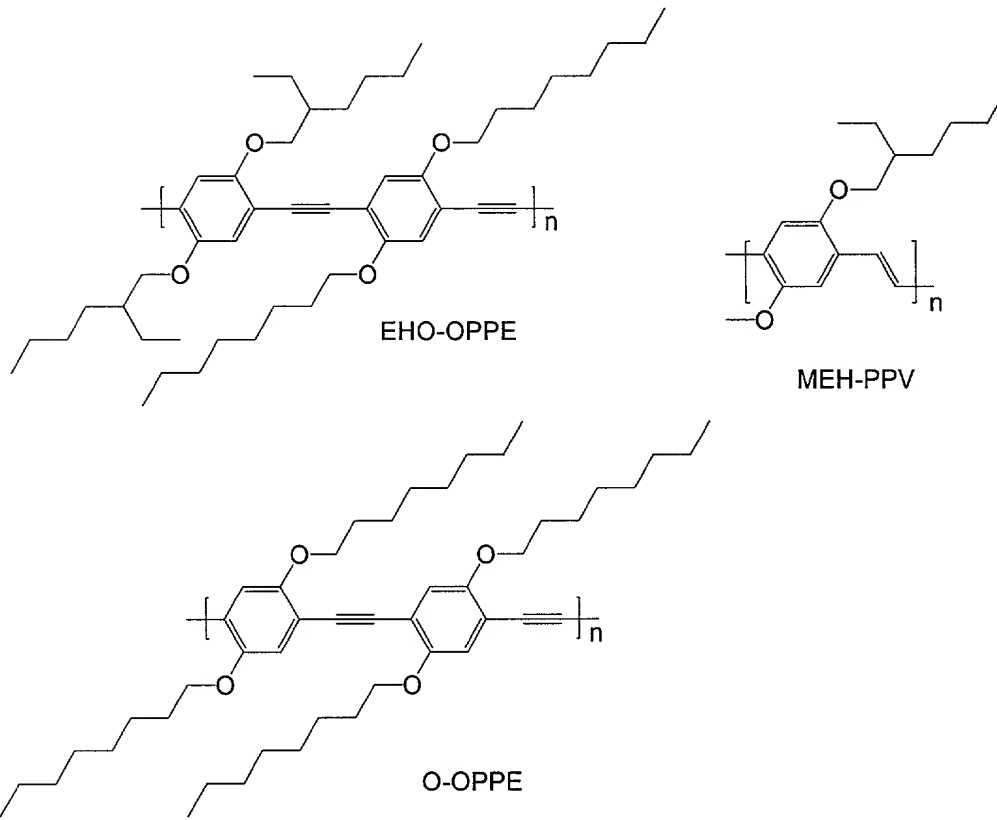
[0018] According to the present invention, such materials can be brought into a suitable form and used to produce security elements from which security papers and security items can be fabricated. The security element may be embodied in a wide variety of forms, including but not limited to fibers, threads, strips, films, sheets, layers, tapes, sheeting, disks, chips and/or combinations thereof. In addition, security elements may also be used in more complex forms including but not limited to logos, letters, characters, numerals, etc. In addition, the surface of the security element may be

structured, for example, by printing or embossing. The essential feature of the security items according to the present invention is that the security element has at least one photoluminescent segment which is characterized by a linearly polarized photoluminescence and/or a linearly polarized absorption, or the security element has at least one segment characterized by a linearly polarized absorption.

[0019] In the case of photoluminescent segments, it may be advantageous if little or none of the excitation is provided by normal daylight but instead, according to a preferred embodiment of the present invention, an additional light source such as light in the UV range is needed to make the photoluminescence visible. The linearly polarized photoluminescence of such segments then leads to the emitted light being absorbed to different extents by an external polarizer (analyzer), depending on the orientation of the polar axis of the polarizer (analyzer) and the polarization axis of the segment, which can lead to a strong light/dark contrast which can be perceived by the naked eye (and of course also by the polarizer). Naturally, this effect may also be detected with suitable sensors. Likewise, the linearly polarized absorption of such segments leads to the result that linearly polarized excitation light, which may be produced by an external light source in combination with a linear polarizer, for example, is absorbed to different extents by the segment, depending on the orientation of the polarization axis of the segment and the polarization direction of the excitation light, which can lead to a strong contrast between light and dark when observed with the naked eye. In this patent specification, a segment is a portion of an object, in particular a security element, on which the characteristic degree of polarization for emission and absorption can be determined in an adequate manner. It should be obvious for those skilled in the art that the shape and size of these segments may vary from one case to the next and that the polarization measurements can be performed with a wide variety of different experimental arrangements such as conventional

spectrometers, microscopic methods, etc. For example, if a uniaxially oriented film of material A with the dimensions 5 cm x 5 cm x 2 μ m (see example A) is used as the security element, the entire film may optionally be regarded as a segment if the measurement of the degree of polarization may be performed essentially at any point, but basically comparable results with regard to the degree of polarization or the polarization axis can be obtained within the context of measurement accuracy and production accuracy. On the other hand, a fiber shaped into a circle, for example, with a diameter of 0.5 mm, and a length of 20 cm of the same material may be regarded as a combination of many segments because the polarization axis determined from polarization measurements in this case has a strong dependence on position. Of course, this element also has optical effects similar to those described above in the sense of this invention and can be described as a combination of individual segments.

[0020] The security elements in security items according to the present invention contain a luminescent dye or several luminescent dyes in a suitable manner to induce the polarization properties according to the present invention. Suitable photoluminescent dyes include, for example, those described in European Patent Applications 97111229.7 and 98101520.9 and the publications and patents cited in these patent applications. As shown by the following experiments, certain oligomers and polymers such as poly (2,5 dialkoxy-p-phenylene-ethynylene) derivatives such as EHO-OPPE and O-PPE or poly(p-phenylene-vinylene) derivatives such as (poly-2-methoxy-5-[2N-ethylhexyloxy]-p-phenylene-vinylene) (MEH-PPV) are very useful for preferred variants of the present invention:



[0021] Suitable methods of producing security elements for use according to the present invention are described, for example, in European Patent Applications 97111229.7 and 98101520.9 and in the publications and patents cited in those patent applications. As shown by the following experiments, the security elements or segments of such security elements used in security items according to the present invention may be produced by anisotropic deformation of ductile mixtures, for example.

[0022] It should be readily apparent for those skilled in the art that countless embodiments of the security papers and other security items according to the present invention are possible. The idea on which the present invention is based can be applied fundamentally but not exclusively to all previously known security items and security papers having at least one security element comparable to that of the present invention, apart from the linearly polarized photoluminescence, absorption or both, of course. For example, according to a preferred embodiment of the present invention, security

papers in which one or more photoluminescent security fibers or strips having properties according to the present invention have been embedded can be produced according to the present invention. If several such security fibers or strips are used, they may also have different emission colors and may be inserted into certain patterns e.g., in a specific arrangement of the polarization axes according to a preferred variant of the present invention. Similarly, the security elements may also be applied to a substrate such as one made of paper or plastic by lamination, for example. In another preferred embodiment according to the present invention, the security elements are incorporated into the substrate in the form of fibers or they are applied to the substrate. In this variant, the use of security elements having different emission colors may also be advantageous, and the fibers may have a wide variety of forms, e.g., they may be drawn or curved fibers which can lead to different optical effects according to the present invention.

[0023] This invention is explained below in greater detail on the basis of a few examples.

[0024] Example A (outside the scope of the present invention)

Production of suitable luminescent dyes

[0025] The above-mentioned polymers EHO-OPPE, O-OPPE and MEHPPV were produced on the basis of the procedures described by Ch. Weder (Macromolecules (1996) Vol. 29, p. 5157), D. Steiger (Macromol. Rapid Commun. (1997) Vol. 18, p. 643) and U.S. Patent 5,204,038. Two different EHO-OPPE samples with number-average molecular weights M_n of 10,000 g/mol-1 and 84,000 g/mol-1 (HMW-EHO-OPPE) were used. O-OPPE had an M_n of 10,000 g/mol-1 and MEH-PPV had a weight-average molecular weight M_w of approximately 450,000 g/mol-1.

Other materials used

[0026] Ultra-high molecular weight polyethylene (UHMW-PE, Hostalen Gur 412, weight-average molecular weight 4.106 g/mol-1, Hoechst AG) was used as the carrier polymer. Xylene (ultra-high purity, Fluka AG) was used as the solvent.

Characterization of the security elements, segments and materials for security elements:

[0027] The anisotropic photophysical behavior of the security elements, segments and materials used for the security elements was determined by polarized photoluminescence and UV/VIS spectroscopy as described in detail in European Patent Application 98101520.9 by the present applicant.

Production of suitable photoluminescent materials with a polarized emission and linearly polarized absorption:

[0028] Photoluminescent materials with 1 or 2 percent by weight EHD-OPPE with Mn of 10,000 g/mol-1 as the luminescent dye and UHMW-PE as the carrier polymer were produced as described previously (Ch. Weder et al. , *Adv. Mat.*, vol. 9, pp. 1035-1039 (1997)) by pouring a solution containing the luminescent dye (5 or 10 mg) and UHMW-PE (0.5 g) in xylene (50 g) into a petri dish with a diameter of 11 cm. The resulting gels were dried under ambient conditions for 24 hours, resulting in unoriented EHO-OPPE/UHMW-PE films with a thickness of approximately 70 μm . These films were drawn at temperatures of 90 - 120 C to different drawing rates (= length of the drawn film/original length of the film) between 10 and 80. The resulting film had a thickness between 1 and approximately 10 μm .

[0029] This experiment was repeated with EHO-OPPE with Mn of 84,000 g/mol-1, O-OPPE with Mn of 10,000 g/mol-1 and MEH-PPV with Mw of 450,000 g/mol-1.

[0030] The highly drawn samples from this example had a strongly polarized absorption and strongly polarized emission, as shown in Figure 1 for a film of 2 percent by weight EHO-OPPE with a drawing rate of 80. This specific material (referred to as material A in the following examples) has a dichroic ratio in absorption of 57 (measured at an excitation wavelength of 485 nm), a dichroic ratio in emission of 27 and a yellowish green emission color. However, a similar film of 1 percent by weight MEH-PPV with a drawing rate of 80 (referred to as material B in the following examples) has a dichroic ratio in absorption of 21, a dichroic ratio in emission of 27 (measured at an excitation wavelength of 510 nm) and a reddish orange emission color. The effects of the drawing rate, the structure of the luminescent dye, the composition of the material and the excitation wavelength on the dichroic absorption and emission properties are summarized in Figure 2. This example thus illustrates how suitable photoluminescent materials with linearly polarized emission and linearly polarized absorption, from which security elements or segments of such security elements can be produced, can be used in security items according to the present invention.

Example 1

[0031] A security paper was produced by embedding a strip of material A 2 mm wide and approximately 2 μ m thick in a paper I having the dimensions 17 cm x 7 cm such that the polarization axis of the strip was parallel to the short sides of the paper (Figure 3a). The paper 1 was printed 3, and the strip 2 could not be seen well with the naked eye either in normal daylight or in normal room light, in reflection or in transmission. However, the greenish yellow photoluminescence of the strip 2 could be detected immediately with the naked eye if the security paper was observed under a UV

lamp (Bioblock, VL-4LC, 4 watts). When the security paper was observed under such light by means of an external linear polarizer (Polaroid HN32) and was rotated so that its polar axis was oriented either parallel or perpendicular to the short side of the paper 1, a strong contrast between light and dark could be seen with the naked eye in the photoluminescence of the strip 2. A similar effect was obtained when the light of the UV lamp was polarized with a polarizer (Polaroid HNP-B) and the polarizer was rotated so that its polar axis was either parallel or perpendicular to the short side of the paper 1.

Example 2

[0032] Example I was repeated, but in addition a second strip of material B 4 1 mm wide and approximately 2 μ m thick was also embedded in the paper I such that the polarization axis of this strip 4 was parallel to the long sides of the paper 1 (Figure 3b) . The paper I was printed 3 and the strips 2 and 4 could not be discerned well with the naked eye either in normal daylight or in normal room light, in reflection or in transmission. However, the greenish yellow and reddish orange photoluminescence of the two strips 2 and 4 could be detected immediately with the naked eye when the security paper was observed under a UV lamp (Bioblock, VL-4LC, 4 watts) . When the security paper was observed under such light through an external linear polarizer (Polaroid HN32) and this was rotated so that its polar axis was either parallel or perpendicular to the short side of the paper 1, a strong contrast between light and dark could be discerned with the naked eye in the photoluminescence of the two strips 2 and 4, and essentially either the photoluminescence of the greenish yellow 2 or reddish orange 4 strips was visible. A similar effect was obtained when the light of the UV lamp was polarized with a polarizer (Polaroid HNP-B) which was rotated so that its polar axis was either parallel or perpendicular to the short side of the paper 1.

Example 3

[0033] Example 1 was repeated, but instead of the strip, fibers of material A 5 with a diameter between approximately 30 and 400 μm and a length between approximately 1 and 10 mm were embedded in the paper 1 (Figure 3c). The paper 1 was printed 3 and the fibers 5 could not be seen well with the naked eye either in normal daylight or in normal room light, either in reflection or in transmission. However, the greenish yellow photoluminescence of the fibers could be detected immediately with the naked eye when the security paper was observed under a UV lamp (Bioblock VL-4LC, 4 watts). When the security paper was observed under such light through an external linear polarizer (Polaroid HN32) which was rotated, a strong contrast could be discerned between light and dark in the photoluminescence of each individual fiber 5. A similar effect was obtained when the light of the UV lamp was polarized with a polarizer (Polaroid HNP-B) which was rotated.

Example 4

[0034] A security card was produced by laminating a strip of material A 7 0.5 mm wide and approximately 2 μm thick onto a transparent card 6 made of yellow-pigmented PVC with the dimensions 8 cm x 5 cm, such that the polarization axis of the strip 7 was oriented parallel to the short sides of the card 6 (Figure 3d). The strip 7 could not be discerned well with the naked eye either in normal daylight or in normal room light. However, the greenish yellow photoluminescence of the strip V could be discerned immediately with the naked eye when the card was observed under a UV lamp (Bioblock VL-4LC, 4 watts). When the card 6 was observed through an external linear polarizer under this light and the polarizer was rotated so that its polar axis was either parallel or

perpendicular to the short side of the card 6, a strong contrast between light and dark in the photoluminescence of the strip 7 could be discerned with the naked eye.

Example 5

[0035] Example 4 was repeated, but instead of transparent card 6 made of yellow-colored PVC, a transparent card made of polycarbonate 8 was used, and in addition a second strip of material B 9 0.5 mm wide and approximately 2 pm thick was laminated to it such that the polarization axis of this second strip 9 was oriented parallel to the long sides of the card 8 (Figure 3e). The greenish yellow and reddish orange photoluminescence of the two strips 7 and 9 could be detected immediately with the naked eye when the card 8 was observed under a UV lamp (Bioblock VL-4LC, 4 watts). When the card 8 was observed through an external linear polarizer (Polaroid HN32) under this light and the polarizer was rotated so that its polar axis was either parallel or perpendicular to the short side of the card 8, a strong contrast between light and dark could be discerned with the naked eye in the photoluminescence of the two strip 7 and 9, and essentially either the photoluminescence of the greenish yellow strips 7 or the reddish orange strip 9 was visible. A similar effect was obtained when the light of the UV lamp was polarized with the polarizer (Polaroid HNP-B) and the polarizer was rotated so that its polar axis was either parallel or perpendicular to the short side of the card 8.

CLAIMS

1. A security item, characterized by at least one security element having at least one photoluminescent segment characterized by a linearly polarized photoluminescence and/or linearly polarized absorption.
2. The security item, characterized by at least one security element having at least one segment characterized by a linearly polarized absorption.
3. The security item according to Claims 1 through 2, characterized in that this segment has a dichroic ratio of 2 or more in absorption and/or emission.
4. The security item according to Claims 1 through 2, characterized in that this segment has a dichroic ratio of 5 or more in absorption and/or emission.
5. The security item according to Claims 1 through 2, characterized in that this segment has a dichroic ratio of 10 or more in absorption and/or emission.
6. The security item according to Claims 1 through 5, characterized in that the security element is in a form selected from the group consisting of fibers, threads, strips, films, sheets, layers, tapes, plates, disks, chips and/or combinations thereof.

7. The security item according to Claims 1 through 6, characterized in that apart from the security element, it consists mainly of paper.

8. The security item according to Claims 1 through 6, characterized in that apart from the security element, it contains one or more synthetic polymers.

9. The security item according to Claims 1 and 3 through 8, characterized in that the security element can be excited to luminescence by irradiation with electromagnetic radiation at a wavelength between 200 and 400 nm.

10. The security item according to Claims 1 and 3 through 9, characterized in that the security element includes at least one carrier polymer and one luminescent dye.

11. The security item according to Claims 1 and 3 through 10, characterized in that the luminescent dye is at least one partially conjugated polymer.

12. The security item according to Claims 1 and 3 through 11, characterized in that the luminescent dye is a poly-p-phenylene-ethynylene derivative.

13. A use of the security item according to Claims 1 through 12 for objects whose counterfeiting is to be made difficult or impossible.

14. The use of the security item according to Claims 1 through 12 for objects whose authenticity and/or validity is to be identified.

15. The use of the security item according to Claims 1 through 12 for objects whose identification is to be permitted and/or simplified.

16. The use of the security item according to Claims 1 through 12 for an object from the group consisting of bank notes, checks, stocks and bonds, securities, identification cards, passports, drivers licenses, admission tickets, stamps, bank cards, and credit cards.

17. A method of producing security items according to Claims 1 through 12, characterized, in that an object is provided with a security element which contains at least one segment and is characterized by a linearly polarized photoluminescence and/or a linearly polarized absorption.

ABSTRACT

The present invention describes security paper and security items in general containing at least one security element having at least one photoluminescent segment characterized by a linearly polarized photoluminescence and/or a linearly polarized absorption. The present invention also describes a method of producing such security items as well as the use thereof.

2004-05-24

1/3

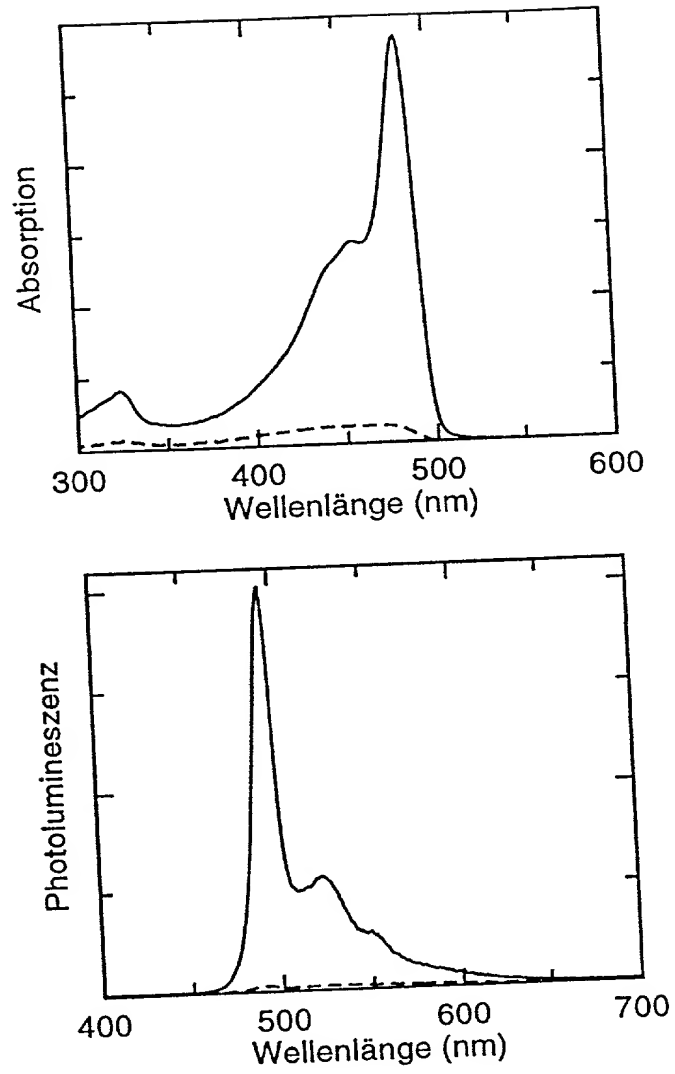
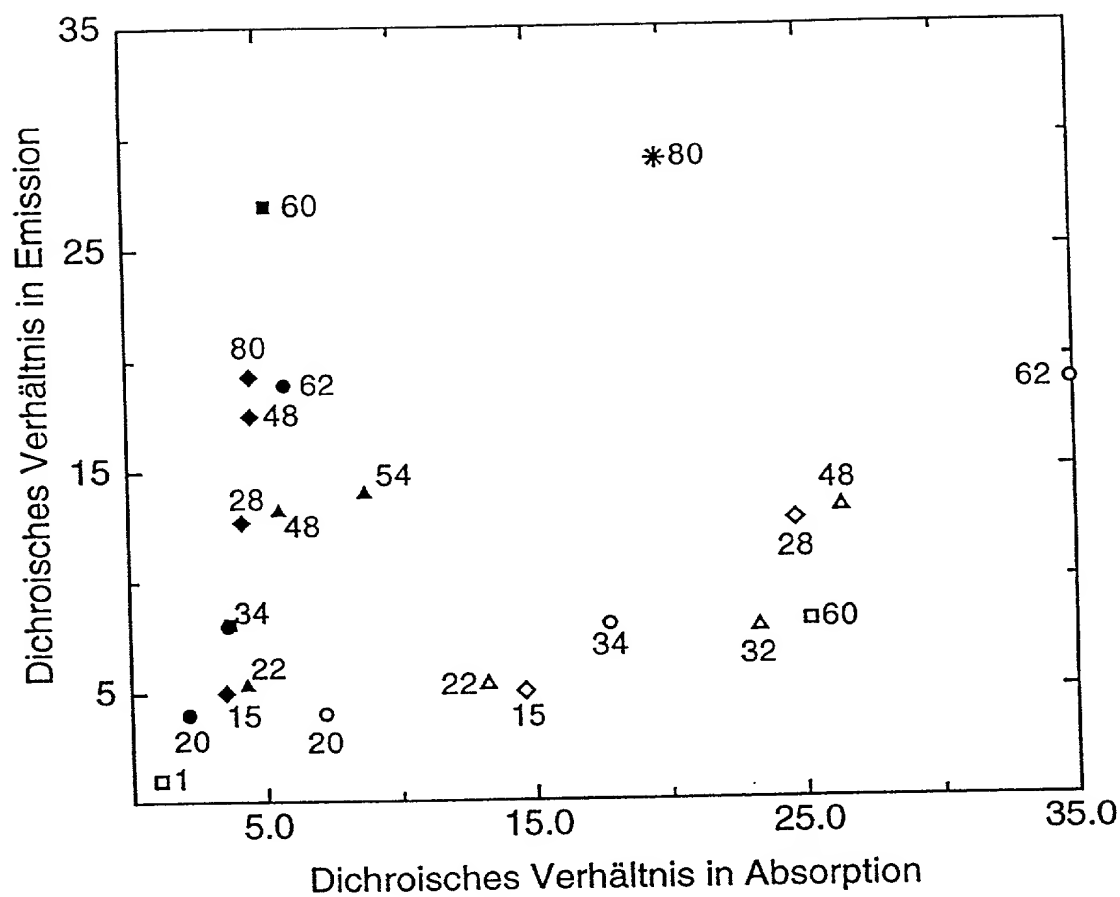


Fig. 1

2/3



- 1 % EHO-OPPE, 485 nm
- 1 % EHO-OPPE, 325 nm
- 2 % EHO-OPPE, 485 nm
- 2 % EHO-OPPE, 325 nm
- ▲ 1 % O-OPPE, 485 nm
- ▲ 1 % O-OPPE, 325 nm
- ◇ 2 % HMW-EHO-OPPE, 485 nm
- ◆ 2 % HMW-EHO-OPPE, 365 nm
- * MEH-PPV, 510 nm

Fig. 2

3/3

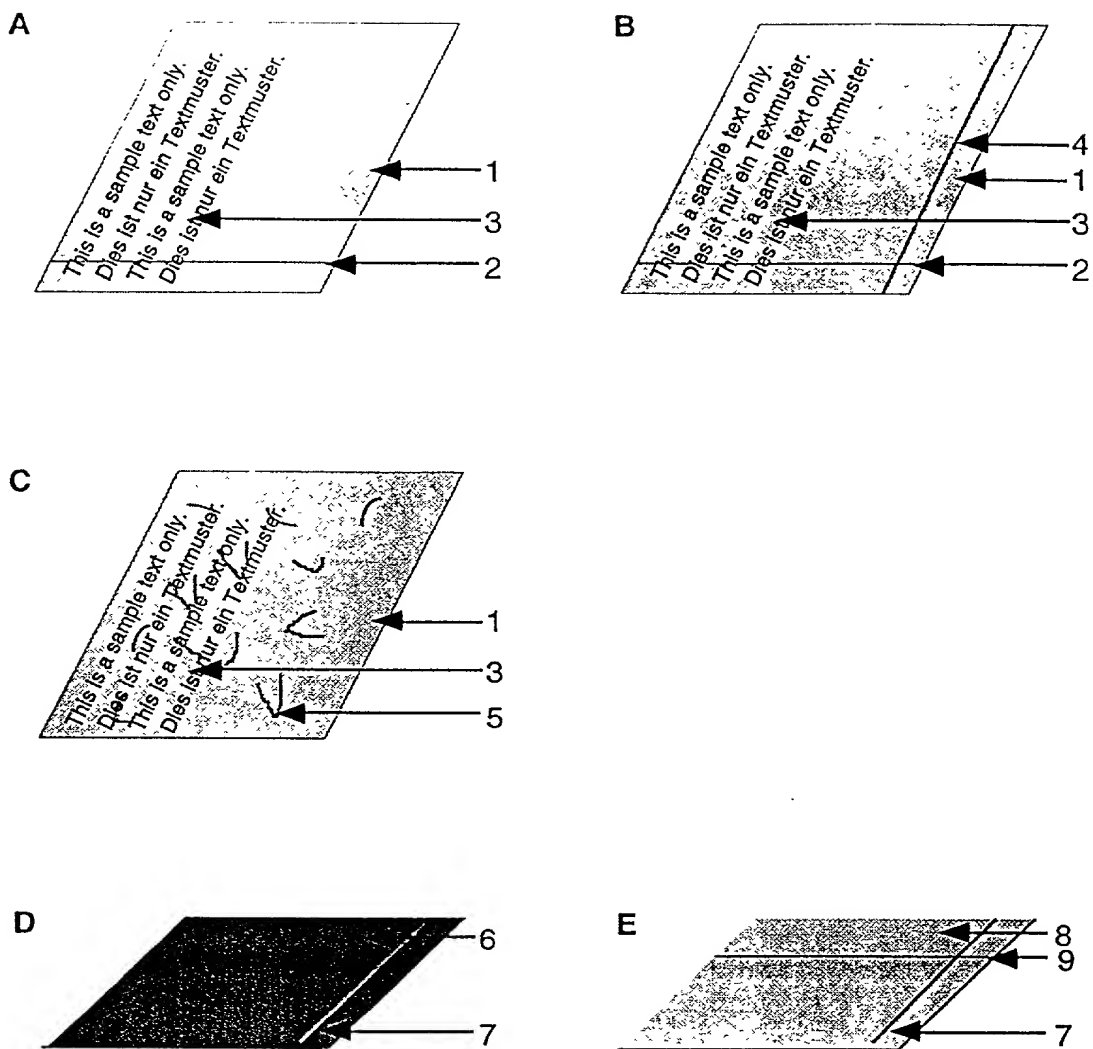


Fig. 3

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

U.S. DEPARTMENT OF COMMERCE
Patent and Trademark Office

ATTORNEY DOCKET NO.: 041463-5026

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

ANTIFALSIFICATION PAPER AND OTHER ANTIFALSIFICATION ITEMS

the specification of which:

is attached hereto; or

was filed as United States application Serial No. _____ on _____ and was amended on _____ (if applicable); or

was filed as PCT international application Number PCT/CH99/00450 on September 22, 1999 and was amended under PCT Article 19 on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the U.S. Patent and Trademark Office information which is material to the patentability of claims presented in this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate or §365(a) of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN APPLICATION(S):

COUNTRY (if PCT, indicate PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED
Switzerland	1958/98	25 September 1998	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No

Combined Declaration For Patent Application and Power of Attorney - (Continued)
(includes Reference to PCT International Applications)

ATTORNEY DOCKET NO.: 041463-5026

I hereby claim the benefits under Title 35, United States Code §119(e) of any United States provisional application(s) listed below.

U.S. PROVISIONAL APPLICATIONS

U.S. PROVISIONAL APPLICATION NO.	U.S. FILING DATE

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or §365(c) of any PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to the patentability of claims presented in this application in accordance with Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT:

U.S. APPLICATIONS		STATUS (Check One)		
U.S. APPLICATION NO.	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

POWER OF ATTORNEY: As a named inventor, I hereby appoint the registered practitioners of Morgan, Lewis & Bockius LLP included in the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to that Customer Number.

Customer Number: 009629

Direct Telephone Calls To:
(name and telephone number)

Robert J. Gaybrick
202-467-7000

Combined Declaration For Patent Application and Power of Attorney - (Continued)
(includes Reference to PCT International Applications)

ATTORNEY DOCKET NO.: 041463-5026

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

FULL NAME OF SOLE
OR FIRST INVENTOR

1-10
Christoph WEDER

RESIDENCE &
CITIZENSHIP

Gattikon, Switzerland CHX

COUNTRY OF
CITIZENSHIP
Switzerland

POST OFFICE ADDRESS

Hofstrasse 25, 8136 Gattikon, Switzerland

FIRST OR SOLE INVENTOR'S SIGNATURE

DATE

July 22, 2001

FULL NAME OF
SECOND INVENTOR

2-10
Paul Smith

RESIDENCE &
CITIZENSHIP

Zürich, Switzerland CHX

COUNTRY OF
CITIZENSHIP
The Netherlands

POST OFFICE ADDRESS

Huttensteig 10, 8006 Zürich, Switzerland

SECOND INVENTOR'S SIGNATURE

DATE

July 18, 2001

FULL NAME OF THIRD
INVENTOR

RESIDENCE &
CITIZENSHIP

COUNTRY OF
CITIZENSHIP

POST OFFICE ADDRESS

THIRD INVENTOR'S SIGNATURE

DATE

Listing of Inventors Continued on attached page(s) [] Yes [X] No